C9150 8715 bb.125
p14/2

THE
DESCRIPTION AND USE
OF AN OPAKE
SOLAR MICROSCOPE.

IN WHICH

All Opake Bodies, whether of Animal, Vegetable, Fossil, or Marine Production, are ſhewn in the greateſt Perfection, in all their native Beauties, of Lights, Shades, Prominences, Cavities; and all Variety of different Hues, Tints, and Colours, heightened by Reflection of Solar Rays condenſed upon them, to an amazing Degree: At the ſame Time all Transparent Objects are alſo ſhewn in a new Light, and in a manner peculiar to this Inſtrument.

Illuſtrated by a Copper-plate Section of the Microscope in its full Length.

By B. MARTIN.

LONDON:
Printed for the Author, N°. 171, in Fleet-Street, 1774.

PREFACE.

THE *Rationale of an* Opake Solar Microscope *is perfectly Philoſophical; for as the Viſion of all Objects is effected by Rays of Light proceeding from them by* Reflection *or* Refraction, *ſo they will appear more or leſs perfect and beautiful, in Proportion as they are more or leſs illuſtrated by luminous Rays which fall upon them. But as far the greater Part of the Objects we ſee, are of the* Opake Sort, viz. *ſuch whoſe* Surfaces *only are to be ſeen, it is evident, that the more you can illuminate and magnify them, the greater will be the Perfection in which they will appear. To* Magnify *them is neceſſary to a more compleat View of them; but then their natural Brightneſs (without additional Light) will be diminiſhed, as in the common* Reading Glass. *The uſual* Solar Microscope *ſhews not the Surface of any Object; the* Compound Microscope *ſhews the Surfaces only of very ſmall Objects, and the Images in ſuch a Situation, to which the Hand cannot be applied. But the* Opake Microscpe, *not only magnifies the natural Appearance or Size of Objects of every Sort, but at the ſame time throws ſuch a Quantity of Solar Rays upon them, as to make all their Colours appear vaſtly more vivid and ſtrong than to the naked Eye; and their Parts ſo expanded and diſtinct upon a fixed Screen, that they are not only viewed with the utmoſt Pleaſure, but may be drawn with the greateſt Eaſe by any ingenious Hand. They who have not ſeen Objects in this Microſcope will not eaſily be apprized of its Worth and Excellency. I have endeavoured to facilitate the Uſe of it by a Repreſentation of its ſeveral Parts in a Section thereof on a large Copper-plate. And ſuch Gentlemen or Ladies as favour me with the Purchaſe of this Inſtrument, are ſhewn the Uſe of every Part in the* Darkened Room,

By their moſt obedient,

Humble Servant,

B. MARTIN.

BRITISH MUSEUM 4 NOV 53

THE

DESCRIPTION AND USE

OF AN OPAKE

SOLAR MICROSCOPE.

HAVING, for many Years paſt, attempted the CONSTRUCTION of an *Opake* SOLAR MICROSCOPE without Succeſs, in all the common Forms and Sizes of Glaſſes, I had Reaſon, from many Experiments, to ſuppoſe that I miſcarried in two reſpects, *viz.* one in the *Poſition* of the Glaſſes, the other in the *Size* of them. And at length, by a proper Attention to theſe Particulars, I found the Fabrication of an *Opake* SOLAR MICROSCOPE, a Matter of much greater Eaſe, and productive of more delightful Effects, than I ever expected.

I had began this Diſquiſition long before I ſaw that Conſtruction of an *Opake Solar Microſcope* publiſhed (Years ago) in the COMMENTARIES of the IMPERIAL ACADEMY of St. PETERSBURGH, which, as it promiſed little, was found upon Trial, not worth purſuing.

The Structure and Uſe of this Inſtrument (now brought to great Perfection) will be beſt underſtood from a Figure repreſenting a Section thereof Length-wiſe, in its real Size, and a Deſcription of its ſeveral Parts, as follows: (See the *Plate.*)

AB is the *Illuminator*, or Lens refracting the Rays of Solar Light towards a Focus, which it receives by Reflection from a plain Glaſs Speculum on the out-ſide of the Window, moveable into a requiſite Poſition for that Purpoſe.

The Breadth of this Lens is 4¼ Inches, and therefore throws near 10 Times the Light upon the Object, that can be had in the common Solar Microſcope.

CF	is the *Focal Diſtance* of the ſaid Lens, which is about 16 Inches.
F	the Solar Focus thereof.
IKLM	a truncated Cone, or large Part of the Body of the Inſtrument.
KNMO	a ſhort Cylindric Part fixed thereto.
PQ	another Cylindric Part ſliding in the former.
RSTV	a Box containing the ſeveral Glaſſes for illuminating, and magnifying the Objects, *viz.*
DE	a plain Speculum for reflecting the Cone of converging Rays to the Object, by which it is ſtrongly illuminated.
D'	the Baſe of the reflecting Speculum, on which it is moveable on a Hing, by
GH	a Screw paſſing through the Side of the Box, and connected with the Speculum by
G	a Joint, by means of which the Speculum is adjuſted for a proper Reflection of Light.
W	is the opake Object to be magnified.
X	is the firſt Lens concerned in the magnifying Power.
Y	is a compound *Achromatic* Lens, combined with the other for magnifying the Objects.
Z	is the large Image, or magnified Appearance of the opake Object.
a b	is a Lens occaſionally added to encreaſe the Denſity of the Rays upon the Object by ſhortening the focal Diſtance for burning, melting, &c.
c d	the Diameter of the Solar Spot or Focus of Rays (thus ſhortened) at the Object, at the ſame Diſtance GW from the Mirror.
e g	the Diameter of the Cone, or Circle of Light at the Object W, ſufficient for a proper Illumination.
h i	a Tube ſliding in
k l	a Spring-pipe in the Side ST of the Box, exactly againſt the Object, by which a due Focus is procured for any Diſtance of the Screen at Z.
m n	is a Tube or Pipe, with a Screw upon the whole Length, by which it is placed at a requiſite Diſtance from the Achromatic Lens, and thereby the magnifying Power of both combined, is rendered variable at Pleaſure.
o p q r	is the ſmall Caſe or Box containing the Achromatic Lens, with a proper Aperture, for a Diſtinct Appearance of the Image

BRITISH MUSEUM 4 NOV 63

st is a Braſs Plate fixed to the back Part RV of the Box, on which the Sliders with the Objects are moved.
v is an upright Piece of Braſs fixed in the foregoing at (*s*) and ſupports
u a hollow braſs Pipe or Tube fixed on the Top thereof; in which there is a Spiral Wire to act againſt a Shoulder on
wx the Shank or Wire fixed to the Knob *w*, and to
yz the Plate which bears againſt the back Part of the Sliders, or Slider-holder; and is drawn back by the Knob (*w*) and driven forward by the ſaid Spring Wire in (*u*).

Theſe are the ſeveral Parts of which the Opake Solar Microſcope conſiſts, the ſeveral Uſes whereof we ſhall now more particularly declare.

And firſt with regard to the Denſity of Light upon the Opake Object at W, it muſt be conſidered that the Diameter of the Circle of Light upon the Object is about $\frac{3}{4}$ of an Inch; and therefore the Intenſity of the Light is increaſed in the Proportion of the Square of AB to the Square of *eg*, which is nearly that of 30 to 1; which is fully ſufficient to render the moſt Opake or dark Object moſt pleaſingly viſible on the Screen.

But for the Purpoſes of *Burning* or *Melting* any Combuſtible or fuiſible Subſtances, as Turpentine, Pitch, Sulphur, Roſſin, &c. when infuſed and fixed in the Pores of Wood, ſpread on Slips of Paſteboard, or otherwiſe applied, it will be neceſſary to add the Lens (*a b*) which is put into the End of a Braſs Tube, that it may be placed in the ſliding Part PQ belonging to the Box RSTV, and moveable in the Cylinder RNOM; for then the Diameter (*c d*) of the Solar Spot upon the Object is but about $\frac{1}{10}$ of an Inch. And ſo the Heat is in this Caſe encreaſed in the Proportion of AB ſquare to *c d* ſquare, or more than 1600 to 1.

In all common Caſes, the Intenſity of Light and Heat may be conſiderably increaſed or diminiſhed by moving the Slider PQ backwards or forwards in the Socket NOMK, fixed to the Body IKLM of the Inſtrument.

The circular Spot of Light is always kept full upon the Object W by turning the Screw GH, and thereby raiſing or depreſſing (in a ſmall Degree) the Mirror DE; at the ſame time alſo adjuſting the Mirror on the out Side of the Window by the Screw in the lower Part of the Frame, as is done in uſing the Common Solar Microſcope.

The Hole in the Box SV on the hinder Part, where the Object is applied is about one Inch Diameter, the Circle of Light for common Opake Objects a little leſs, and the Object about $\frac{1}{2}$ an Inch Diameter, will have all its Parts repreſented in one

View upon the Screen at Z, which if placed at the Diſtance of 5 Feet, will be about 15 or 16 Inches Diameter, and will be greater or leſs as the Screen is more remote or nearer to the Glaſs Y.

At the ſame Diſtance of the Screen, the Image Z may be made greater or leſſer by varying the Diſtance XY at the ſingle and compound Lenſes; for if X be ſcrewed nearer to Y, the Image is made larger, and *vice verſa.*

By means of ſuch a Combination of Lenſes the *Field of View* or Spaciousneſs of the Picture is greatly enlarged, and thereby the Effect of the Inſtrument is rendered vaſtly more perfect and pleaſing to the Spectator.

By the achromatic Lens Y the Colours of Solar Light are entirely prevented, and all the Variety of Hues, Colours, and Tints which beautify theſe pictureſque Scenes are abſolutely thoſe of the Objects themſelves.

As to the Manner of preparing and applying the Objects, my own is as follows; with a fine Saw I cut tranſverſely all Sorts of vegetable Subſtances, Stems of Shrubs, Boughs of Trees, Stalks of Plants, &c. and paring their Surfaces with a very ſharp Pen Knife or Razor, I ſtick them with Wafers of different Colours to long Slips of Wood, which are ſeverally put between the ſpring Plate *(yz)* and the Box; and thus you have inſtantly in View all the wonderful Variety of ſolid and vacuous Parts in the Structure and Contexture of *Vegetables* of every Kind, and the amazing Order and Form obſerved therein in every particular Species.

In many Sorts of decayed or rotten Wood, as Oak, Elm, Aſh, &c. if you break them carefully croſs the Grain, and alſo longitudinally, you will have the moſt perfect View of the ſeveral component Parts in their perfectly natural State, and wonderful to behold. This, to uſe Horace's Phraſe, is viewing Nature *Simplex Munditiis*, in her native Simplicity diveſted of Art. In the ſame Manner the Roots of Plants are to be treated.

Upon the ſame Slips of Wood you diſplay the Leaves of Trees, the Flowers of Plants, and all the Variety of Seeds, and other Parts; and more eſpecially the Parts of Leaves diſſected by Maceration in Water; all theſe afford an amazing Spectacle to the raviſhed Eye of the Spectator. The Surfaces, Tranſverſe, Sections, &c. of Fruit, Apples, Pears, Plumbs, Apricots, Peaches, Nectarines, Melons, &c. may be viewed this Way to great Advantage.

The Objects preſented by the *Animal Kingdom* for the Opake Solar Microſcope are innumerable, as well as in Reſpect of *whole Animals* of the ſmaller Sort, as the *Parts* of larger ones. Of INSECTS from the Tenth of an Inch to an Inch in Length, what a wonderful Variety do we find for our Inſpection this Way! It would be endleſs to enumerate the Multiplicity of

Parts in their external Structure; their Heads, their Eyes, their *Antennæ* or Feelers, Horns, Wings, Legs, Feet, Tails, Hairs, Briſtles, Protuberances, Cavities, with the inexpreſſible Variety of vivid Colours that adorn many of this Tribe of Animals, eſpecially of the exotic Kinds.

In Regard to Fowls, their Plumage is an inexhauſtible Source of coloured Objects; witneſs the *Peacock's Tail* at home, and the *Humming-Bird* from abroad, the Colours of whoſe Feathers upon the Head, Neck, and Breaſt, glow in this Solar Microſcope beyond burning Charcoal itſelf.

The Abundance of Objects which the OCEAN and RIVERS pour in upon us, for a noble Amuſement by the Opake Microſcope, is eaſy to conceive; the variegated Skins, and Fins of Fiſhes, the prodigious Variety of Forms and Colours of their Scales; and the ineffable Beauties of numberleſs Shells, both ſmall and great, are ſufficient Inſtances thereof.

The *Mineral Kingdom* affords ſuch a Scene of glorious Objects as no Mortal can conceive without *(Autopſia)* the Sight of the Eye itſelf this Way aſſiſted. All the Splendor or Refulgence of the moſt brilliant Objects to the common Sight, are not worthy a Compariſon with the inexpreſſible Luſtre and Glory of theſe. The Grains of Gold, the Vegetation of Silver in the Ore, the aſtoniſhing Colours of Copper Marcaſities, of various Species of Mundic, Pyrites, and a Hundred other foſſil Subſtances are to be met with, which ſupply a new and never-ceaſing Entertainment to the *Virtuoſo* poſſeſſed of ſuch an Inſtrument.

Not only *Opake* but ſome *tranſparent Objects* are viewed to a peculiar Advantage in this Inſtrument. The common Solar Microſcope ſhews nothing but tranſparent Subſtances, and not even the Surfaces of them; but the *Opake Microſcope* ſhews both the internal and external Parts; and for this Purpoſe there is a white Piece of Ivory fixed upon the interior Surface of the ſpring Plate *(y z)* as a proper Ground for all ſuch pellucid Objects, any one may eaſily be convinced of this Peculiarity by thus viewing the Wings of the *Libella*, or Adderſpear, and many other Inſects.

The WORKS of ART as well as NATURE, furniſh many curious Objects for the Opake Solar Microſcope; ſuch as ſmall Pictures in Miniature, the Baſs Reliefs on Medals, all Sorts of Cameos and Intaglios, curious Tiſſues, Texture of Silks, Laces, and Embroideries, with many other Objects glowing with Colours, and richly wrought.

As many of theſe Objects are of an irregular Figure, and ſometimes of a conſiderable Thickneſs, it will be neceſſary to have different Sorts of ~~Sliders in Wood, and~~ Slider-holders in Braſs, ſome of which graſp the Object like Spring-tongs, and ſhew both Sides of flat ones; others are ſo formed as to exhibit every

Side

Side of unevenly fractured Objects, particularly thoſe of the mineral and foſſil Kinds. And theſe may ſuggeſt to Gentlemen the Invention of many others for their own Uſe.

I ſhall juſt mention for the ſake of the inquiſitive Connoiſſeur, that an *OpakeSolar* MEGALASCOPE may be conſtructed in a ſimilar Manner, by a larger Speculum DE placed nearer to the Illuminator ABC, by which means a Circle of Light may be thrown upon Objects an Inch wide and more, and of any Length; and yet ſufficiently denſe to ſhew them very bright and very diſtinct; thus the whole Wings of large Inſects, large Sections of Wood, large Shells, Fragments of Foſſils and Ores, large Branches of Corallines, Madrepores, and other Marine Productions, are ſhewn to the greateſt Advantage and Perfection. A Variety of ſuch Objects I have always by me, and both the *Opake Microſcope* and *Megalaſcope* to gratify any Gentleman's Curioſity, who really intends purchaſing of either.

I ſhall conclude this Eſſay with only obſerving, that all the *Apparatus* of the common Solar Microſcope for ſhewing *Tranſparent Objects* is ſold with this; and that the Effect is as much greater in this than it is in that, as the Glaſſes are larger; for in ſuch Caſes they render the Object more luminous in Proportion, and conſequently the View of Objects more grand, noble, and delightful; in ſhort, were the Room large enough, there would be Light ſufficient for a Field of View 16 or 20 Feet in Diameter, as I have often made it for my own Entertainment. And with reſpect to the minuteſt Objects, the Light being ſo great, it is amazing to ſee in how great Perfection they appear when magnified to an enormous Size; thus the Lenſes of a Lobſter's Eye are 6 Inches Square on the Screen at 5 or 6 Feet from the Window, and the circular Image of the Sun (or *Focal Point)* in each, more than an Inch in Diameter; an Object never before ſhewn in any Microſcope.

In the ſame *Apparatus* is alſo included that of the Solar Megalaſcope for all the larger Sort of ſmall Objects, or for any tranſparent Object about one Inch wide, and 1½ or 2 Inches long, which, when beautifully coloured and figured, make a moſt rational Entertainment for the Man of Taſte.

Laſtly, in the ſame *Apparatus* is the moſt compleat Set of Magnifiers, Sliders of Objects for the *Wilſon*'s, or *Single Microſcope*; ſo that the whole is an Univerſal Apparatus for *Optical* VIEWS in every Way; and may be juſtly conſidered as the moſt general and genuine EXPOSITOR of the BIBLE of NATURE, which contains a *Rational* SYSTEM of TRUE RELIGION, in every reſpect worthy of, and adapted to the HUMAN MIND, which it expands and repletes with all the PRINCIPLES of WISDOM, PIETY, and DEVOTION.

BRITISH MUSEUM NOV

A SECTION of the OPAKE SOLAR MICROSCOPE B:MARTIN invent.^{t} 1770.